Increased cell functions using BMP-7 functionalized rosette nanotubes*

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Bone has a limited capability to heal following large defects caused by traumatic bone loss, bone tumors or infections. Bone morphogenetic protein 7 (BMP-7), approved by the FDA for orthopedic applications in 2001, is one of the most important cytokines of the transforming growth factor beta family involved in skeletal development and bone remodeling. However, the amount of BMP-7 needed for inducing bone growth is on the order of milligrams due to a short half-life, which is extremely high and might cause a variety of adverse effects ranging from inflammatory responses to excessive bone growth. As a result, a novel delivery system has to be developed to prolong BMP-7 retention and therefore reduce such a high dose. In addition, due to the high cost of the production and instabilities of all BMP proteins, previous researchers have identified several peptide sequences from the knuckle epitope of BMP proteins and showed that these peptides have similar capability to promote bone cell functions. According to a previous study, short peptides derived from the BMP-7 knuckle epitope (peptide A (SNVILKKYRN), B (KPSSAPTQLN), and C (KAISVLYFDDS)) were able to promote osteoblast functions in vitro[1]. In this study, the use of the BMP-7 short peptides aforementioned were further improved for orthopedic applications by covalently connecting them to twin G∧C base-derived rosette nanotubes[2-4]. Specifically, in cell proliferation studies, A-RNT and B-RNT increased osteoblast density by 177% and 165%, respectively, compared to the control groups over the course of 5 days. For fibroblasts (a major competitve cell to osteoblasts), B-RNT, C-RNT and A/C-RNT promoted the highest fibroblast density after 5 days of culturing. Moreover, it is worth mentioning that osteoblasts did achieve higher densities than fibroblasts after 5 days, which clearly provides some advantages of the present materials for bone applications. The mechanism of increased bone cell functions in the presence of such materials will be examined by qPCR.

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